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USDA Forest Service

Rocky Mountain Forest and  
Range Experiment Station

## Classification of the Forest Vegetation on the National Forests of Arizona and New Mexico

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Forest vegetation classified by habitat types and community types in Arizona and New Mexico are tabulated. Eleven series and 123 habitat and community types are identified; however, these habitat types and community types have been grouped into a lesser number of categories having similar characteristics or synonymous names. The table includes the name, location, relative site, successional status, tree and principal undergrowth associates, and the authority.

**Keywords:** Vegetation classification, habitat type, community type, *Pinus leiophylla*, *Pinus engelmannii*, *Pinus ponderosa*, *Pinus strobiformis*, *Pseudotsuga menziesii*, *Picea pungens*, *Abies concolor*, *Pinus flexilis*, *Picea engelmannii*, *Abies lasiocarpa*, and *Pinus aristata*

Classification of forest land into units of like biological potential is helpful for land managers, planners, and researchers who must communicate effectively with several disciplines during the decisionmaking process. Furthermore, if the capabilities and limitations of forest land units cannot be identified, there is no basis for selecting areas most useful for research or the geographical extent to which research findings can be extrapolated.

Research was begun in 1974 to classify the forest lands of Arizona and New Mexico into habitat types or community types. This paper provides a summary tabulation and brief description of the forest habitat and community types of Arizona and New Mexico (table 1). Detailed descriptions and the associated management implications of each unit are given in the publications cited as the authority in table 1. Readers who are interested in cross-referencing similar habitat types elsewhere are directed to Alexander (1985).

Because terminology in ecology is not uniformly used or understood, the terms and concepts used in this paper are defined below.

"Climax" vegetation is that which has attained a steady state with its environment; species forming the climax

vegetation successfully maintain their population sizes indefinitely over time. Tansley (1935) proposed recognizing climatic, edaphic, and physiographic climaxes; he also discussed fire and biotic climaxes. Daubenmire (1952) used this approach, with modifications, in his classification of forest vegetation in the northern Rocky Mountains. Daubenmire (1968), Daubenmire and Daubenmire (1968), Hoffman and Alexander (1976), Pfister et al. (1977), and Pfister and Arno (1980) further elaborated on the definitions, usage, and limitations. "Climatic climax" vegetation develops on "normal" regional topography with deep, well-drained, well-developed soils. "Normal" topography in mountainous regions is necessarily different from that of plains regions. Where soils or topography exert sufficient influence to produce self-perpetuating vegetation distinct from the climatic climax, the terms "edaphic climax" and "topographic climax," respectively, are used to describe the steady-state vegetation. Where special topographic conditions also favor the development of edaphic conditions distinct from the "normal," the term "topo-edaphic climax" often is used in descriptions of the resulting steady-state vegetation. Where recurring disturbance, such as grazing or fire, exerts a predominant influence on the composition or structure of steady-state vegetation, the term "disclimax" is used. In the absence of the disturbing factor, or factors, it is possible the vegetation will revert to the primary climax. "Seral" vegetation is that which has not attained a steady state; current popula-

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tions of some species are being replaced by others. In some instances, trends toward the climax vegetation can be identified; in others, these trends are not evident; and in still others, the vegetation may not attain the climax.

If, however, trends in succession within seral communities are not known or cannot be determined, then there is no basis for recognizing habitat types in those areas. These communities will be classified as "community types." Conversely, if "seral" communities do not succeed to "climaxes," they usually are treated as stable plant communities (climaxes).

"Habitat type" is the basic unit in classifying lands based on potential (climax) natural vegetation. A habitat type represents, collectively, all parts of the landscape that support, or have the potential of supporting, the same climax vegetation. The climax vegetation upon which the classification is based is called a "plant association." The first level of the classification is the "series," which is the grouping of all plant associations having the same overstory (climax) dominants. For example, all habitat types with *Pinus leiophylla* as the potential climax dominant are grouped into the *Pinus leiophylla* series. The series is more than an artificial grouping of habitat types that uses the potential climax overstory dominant as the convenient thread of continuity. There is an ecologic basis for grouping habitat types into series. For example, *Pinus leiophylla* occupies areas that are warmer and drier than areas where *Pinus engelmannii* is climax. Continuing higher into the mountains of New Mexico and Arizona, *Pinus ponderosa*, *Pseudotsuga menziesii*, *Abies concolor*, *Picea pungens*, *Abies lasiocarpa*, and *Picea engelmannii* successively become the dominant vegetation (Layser and Schubert 1979).

Habitat types within a series are distinguished on the basis of undergrowth unions, the smallest "structural unit" of the vegetation. Each union consists of one or more undergrowth species that exhibit similar microenvironmental requirements. The indicator undergrowth species for each habitat type may vary from place to place, but the variation is within narrow limits. Theoretically, good indicator species are those confined entirely, or nearly so, to a particular habitat type. Practically, such species are rare and difficult to observe. The best indicator undergrowth species are those that are relatively common, can be easily observed, have high constancy in the particular habitat type, and have limited distribution in other habitat types. The occurrence of more than one indicator species usually is more reliable than the occurrence of just one. Some undergrowth species have wide occurrence and little indicator significance.

The term "community type" has been used to identify vegetation which may be either (1) climax, but about which there is uncertainty, or (2) seral, but the trend toward climax is not evident; or (3) the recognized plant community in place varies at any given time. Community types have one or more overstory dominants and characteristic undergrowth species. The undergrowth may be climax, but the overstory dominants are often long-lived, seral species that may be self-perpetuating because of repeated disturbance that prevents or slows down the succession to climax vegetation.

There are some items in table 1 that need further clarification:

1. The description of the site (i.e., warm dry, cool dry, etc.) refers only to the series and location and, therefore, is relative. Obviously, a warm dry *Pinus ponderosa* site is not the same as a warm dry *Abies lasiocarpa* site.

2. In those habitat types where more than one phase is recognized, the typic phase is listed first, followed by the other phases. "Phase" is a subdivision of a habitat type representing a characteristic variation in climax vegetation and environmental conditions.

3. Synonyms of habitat types and closely related habitat types (which may be the same habitat type) are included within brackets.

4. Under the heading "Principal undergrowth species," the undergrowth species for which the habitat type is named is listed first, followed in order by shrubs, graminoids, and forbs.

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Table 1.—Habitat types and community types for forest vegetation in Arizona and New Mexico

Habitat type or community type	Location	Site	Successional status	Tree associates	Principal undergrowth species	Authority
<i>Pinus leiophylla</i> series						
<i>Pinus leiophylla</i> / <i>Arctostaphylos pungens</i> C.T.	Mountains of south-central Arizona	Hot dry	<i>P. leiophylla</i> probably climax	<i>Juniperus deppeana</i>	<i>A. pungens</i> , <i>Quercus</i> spp.	Muldavin et al. <sup>1</sup>
<i>Pinus leiophylla</i> / <i>Quercus arizonica</i> H.T.	Mountains of south-central Arizona	Hot dry	<i>P. leiophylla</i> usually climax. <i>Pinus ponderosa</i> may be co-climax	<i>P. ponderosa</i> <i>Pinus discolor</i> <i>J. deppeana</i>	<i>Q. arizonica</i> <i>Arctostaphylos</i> spp. <i>Quercus</i> spp. <i>Rhus aromatica</i> <i>Muhlenbergia longiligula</i>	DeVelice and Ludwig <sup>2</sup> Muldavin et al. <sup>1</sup>
<i>Pinus leiophylla</i> / <i>Quercus emoryi</i> H.T.	Naegelin Plateau, Patagonia Mountains, and Cabelo Hills, Arizona	Hot dry	<i>P. leiophylla</i> climax	<i>P. discolor</i> <i>J. deppeana</i>	<i>Q. emoryi</i> <i>Q. arizonica</i> <i>Aristida orcuttiana</i> <i>Muhlenbergia</i> spp.	Muldavin et al. <sup>1</sup>
<i>Pinus leiophylla</i> / <i>Quercus hypoleucoides</i> H.T.	Mountains of south-central Arizona	Hot dry	<i>P. leiophylla</i> climax	<i>P. discolor</i> <i>J. deppeana</i>	<i>Q. hypoleucoides</i> <i>Q. arizonica</i> <i>Muhlenbergia</i> spp.	DeVelice and Ludwig <sup>2</sup> Muldavin et al. <sup>1</sup>
<i>Pinus leiophylla</i> / <i>Quercus toumeyi</i>	Chiricuhua Mountains, Arizona	Hot dry	<i>P. leiophylla</i> climax	<i>J. deppeana</i>	<i>Q. toumeyi</i> <i>A. pungens</i>	DeVelice and Ludwig <sup>2</sup>
<i>Pinus leiophylla</i> / <i>Piptochaetium fimbriatum</i> H.T.	Chiricuhua, Patagonia, and Pinaleno Mountains, Arizona	Hot moist	<i>P. leiophylla</i> climax	<i>Cupressus arizonica</i> <i>J. deppeana</i> <i>Juniperus erythrocarpa</i>	<i>P. fimbriatum</i> <i>Juglans major</i> <i>Quercus</i> spp. <i>Prunus serotina</i>	DeVelice and Ludwig <sup>2</sup> Muldavin et al. <sup>1</sup>
<i>Pinus engelmannii</i> series						
<i>Pinus engelmannii</i> / <i>Quercus arizonica</i> H.T.	Chiricahua Mountains, Arizona	Warm very dry	<i>P. engelmannii</i> climax	<i>P. leiophylla</i> <i>P. discolor</i> <i>J. deppeana</i>	<i>Q. arizonica</i> <i>Quercus</i> spp.	DeVelice and Ludwig <sup>2</sup>
<i>Pinus engelmannii</i> / <i>Quercus emoryi</i> H.T.	Conelo Hills, Coronado National Forest, Arizona	Warm very dry	<i>P. engelmannii</i> climax	<i>P. leiophylla</i> <i>J. deppeana</i>	<i>Q. emoryi</i> <i>Muhlenbergia emerstayi</i> <i>M. longiligula</i>	Muldavin et al. <sup>1</sup>
<i>Pinus engelmannii</i> / <i>Quercus hypoleucoides</i> H.T.	Chiricahua and Santa Rita Mountains, Arizona	Warm very dry	<i>P. engelmannii</i> climax	<i>P. leiophylla</i> <i>P. discolor</i> <i>J. deppeana</i>	<i>Q. hypoleucoides</i> <i>Q. arizonica</i> <i>M. longiligula</i>	DeVelice and Ludwig <sup>2</sup> Muldavin et al. <sup>1</sup>
<i>Pinus engelmannii</i> / <i>Quercus rugosa</i> H.T.	Santa Rita Mountains, Arizona	Warm very dry	<i>P. engelmannii</i> climax	<i>P. leiophylla</i> <i>J. deppeana</i>	<i>Q. rugosa</i> <i>M. longiligula</i>	Muldavin et al. <sup>1</sup>
<i>Pinus engelmannii</i> / <i>Muhlenbergia longiligula</i> H.T.	Chiricahua Mountains, Arizona	Warm dry	<i>P. engelmannii</i> climax	<i>P. discolor</i>	<i>M. longiligula</i> <i>Quercus</i> spp.	DeVelice and Ludwig <sup>2</sup>
<i>Pinus ponderosa</i> series						
<i>Pinus ponderosa</i> / <i>Arctostaphylos pungens</i> C.T. [ <i>P. ponderosa</i> / <i>Arctostaphylos</i> spp. C.T.] [ <i>P. ponderosa</i> /Mixed chaparral C.T.]	Mountains of Arizona	Warm dry	<i>P. ponderosa</i> climax	Usually pure stands	<i>A. pungens</i> <i>Arctostaphylos</i> spp. <i>Quercus</i> spp. <i>Bouteloua gracilis</i> <i>Muhlenbergia virescens</i>	Fitzhugh et al. 1987 Hanks et al. 1983 Muldavin et al. <sup>1</sup>
<i>Pinus ponderosa</i> / <i>Arctostaphylos uva-ursi</i> H.T.	Jemez and Sangre de Cristo Mountains, northern New Mexico	Warm dry	<i>P. ponderosa</i> climax	<i>Pseudotsuga menziesii</i> (minor climax)	<i>A. uva-ursi</i> <i>Quercus gambelii</i> <i>Festuca arizonica</i> <i>Muhlenbergia montana</i> <i>Carex heliophila</i> <i>Carex rossii</i>	DeVelice et al. 1986
<i>Pinus ponderosa</i> / <i>Artemisia arbuscula</i> H.T.	San Juan Mountains, New Mexico	Warm dry	<i>P. ponderosa</i> climax	<i>Pinus edulis</i> <i>Juniperus scopulorum</i>	<i>A. arbuscula</i> <i>Q. gambelii</i> <i>B. gracilis</i> <i>C. heliophila</i>	DeVelice et al. 1986
<i>Pinus ponderosa</i> / <i>Cowania mexicana</i> C.T.	Mountains of northern Arizona	Warm dry	<i>P. ponderosa</i> climax	Usually pure stands. May contain <i>P. edulis</i> <i>Juniperus osteosperma</i>	<i>C. mexicana</i> <i>B. gracilis</i> <i>M. montana</i> <i>Poa fendleriana</i>	Hanks et al. 1983
<i>Pinus ponderosa</i> / <i>Juglans major</i> H.T.	Mountains of south-central Arizona	Warm moist	<i>P. ponderosa</i> climax	Usually pure stands	<i>J. major</i> <i>Agropyron</i> spp. <i>Poa</i> spp.	Muldavin et al. <sup>1</sup>
<i>Pinus ponderosa</i> / <i>Quercus arizonica</i> H.T. <i>Q. arizonica</i> (typic) phase <i>Bouteloua gracilis</i> phase	Mountains of southern Arizona	Hot dry	<i>P. ponderosa</i> climax	<i>J. deppeana</i>	<i>Q. arizonica</i> <i>Ceanothus fendleri</i> <i>Quercus</i> spp. <i>B. gracilis</i> <i>M. longiligula</i>	DeVelice and Ludwig <sup>2</sup> Muldavin et al. <sup>1</sup>
<i>Pinus ponderosa</i> / <i>Quercus emoryi</i> H.T.	Mountains of south-central Arizona	Warm dry	<i>P. ponderosa</i> climax	<i>J. deppeana</i>	<i>Q. emoryi</i> <i>Arctostaphylos</i> spp. <i>C. fendleri</i> <i>Quercus</i> spp.	Muldavin et al. <sup>1</sup>

<i>Pinus ponderosa</i> <i>Quercus gambelii</i> H.T. [ <i>P. ponderosa</i> / <i>Poa fendleriana</i> C.T.] <i>Q. gambelii</i> (typic) phase <i>Pinus edulis</i> phase <i>Bouteloua gracilis</i> phase <i>Festuca arizonica</i> phase <i>Muhlenbergia longiligula</i> phase <i>Schizachyrium scoparium</i> phase	Mountains of New Mexico and Arizona	Warm dry	<i>P. ponderosa</i> climax	<i>P. edulis</i> <i>P. discolor</i> <i>Juniperus monosperma</i> <i>J. scopulorum</i>	<i>Q. gambelii</i> <i>C. fendleri</i> <i>Bromus</i> spp. <i>B. gracilis</i> <i>F. arizonica</i> <i>M. longiligula</i> <i>M. montana</i> <i>P. fendleriana</i> <i>S. scoparium</i> <i>Carex</i> spp.	Alexander et al. 1984a, 1987 DeVelice et al. 1986 DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Hanks et al. 1983 Muldavin et al. <sup>1</sup> Fitzhugh et al. 1987
<i>Pinus ponderosa</i> <i>Quercus grisea</i> H.T. <i>Muhlenbergia longiligula</i> phase <i>Muhlenbergia montana</i> phase	Southern mountains of New Mexico and central Arizona	Warm dry	<i>P. ponderosa</i> climax or co-climax with <i>P. edulis</i> <i>J. deppeana</i> <i>J. monosperma</i>	<i>P. edulis</i> <i>J. deppeana</i> <i>J. monosperma</i> <i>P. menziesii</i>	<i>Q. grisea</i> <i>B. gracilis</i> <i>M. longiligula</i> <i>M. montana</i> <i>P. fendleriana</i>	
<i>Pinus ponderosa</i> <i>Quercus hypoleucoides</i> H.T.	Mountains of southern Arizona	Warm dry	<i>P. ponderosa</i> climax	<i>J. deppeana</i>	<i>Q. hypoleucoides</i> <i>Quercus</i> spp. <i>P. fendleriana</i> <i>M. longiligula</i>	DeVelice and Ludwig <sup>2</sup> Muldavin et al. <sup>1</sup>
<i>Pinus ponderosa</i> <i>Quercus rugosa</i> H.T.	Pinaleno, Santa Catalina, Santa Rita, and Huachuca Mountains, Arizona	Warm moist	<i>P. ponderosa</i> climax	<i>Pinus strobiformis</i> <i>P. menziesii</i>	<i>Q. rugosa</i> <i>Quercus</i> spp.	DeVelice and Ludwig <sup>2</sup> Muldavin et al. <sup>1</sup>
<i>Pinus ponderosa</i> <i>Quercus undulata</i> H.T. <i>Q. undulata</i> (typic) phase <i>Muhlenbergia dubia</i> phase <i>Muhlenbergia longiligula</i> phase	Mountains of New Mexico and southeastern Arizona	Hot dry	<i>P. ponderosa</i> climax	<i>P. edulis</i> <i>P. menziesii</i> <i>P. strobiformis</i> <i>Juniperus</i> spp.	<i>Q. undulata</i> <i>Aristida arizonica</i> <i>Andropogon</i> spp. <i>Bouteloua</i> spp. <i>M. dubia</i> <i>M. longiligula</i> <i>Artemisia ludoviciana</i>	Alexander et al. 1984a DeVelice et al. 1986
<i>Pinus ponderosa</i> <i>Ribes inerme</i> H.T. (Scree forest)	Mountains of eastern Arizona and New Mexico	Warm dry	<i>P. ponderosa</i> climax	<i>P. menziesii</i> <i>P. edulis</i> <i>J. deppeana</i> <i>J. scopulorum</i>	<i>R. inerme</i> <i>Quercus</i> spp. <i>Muhlenbergia</i> spp.	DeVelice et al. 1986
<i>Pinus ponderosa</i> <i>Bouteloua gracilis</i> H.T. <i>B. gracilis</i> (typic) phase <i>Pinus edulis</i> phase <i>Artemisia tridentata</i> phase <i>Quercus gambelii</i> phase <i>Andropogon hallii</i> phase <i>Schizachyrium scoparium</i> phase <i>Vitis arizonica</i> phase	Mountains of northern and eastern Arizona and New Mexico	Warm very dry	<i>P. ponderosa</i> climax	<i>P. edulis</i> <i>Juniperus</i> spp.	<i>B. gracilis</i> <i>A. tridentata</i> <i>Q. gambelii</i> <i>A. hallii</i> <i>Muhlenbergia</i> spp. <i>Poa</i> spp. <i>S. scoparium</i> <i>V. arizonica</i>	Alexander et al. 1987 DeVelice et al. 1986 DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Hanks et al. 1983 Muldavin et al. <sup>1</sup>
<i>Pinus ponderosa</i> <i>Festuca arizonica</i> H.T. <i>F. arizonica</i> (typic) phase <i>Quercus gambelii</i> phase <i>Bouteloua gracilis</i> phase <i>Danthonia parryi</i> phase	Mountains of Arizona and New Mexico	Warm dry	<i>P. ponderosa</i> climax	<i>P. edulis</i> <i>P. strobiformis</i> <i>Juniperus</i> spp.	<i>F. arizonica</i> <i>C. fendleri</i> <i>Q. gambelii</i> <i>Ribes cereum</i> <i>B. gracilis</i> <i>D. parryi</i> <i>M. montana</i>	Alexander et al. 1987 DeVelice et al. 1986 Fitzhugh et al. 1987 Hanks et al. 1983
<i>Pinus ponderosa</i> <i>Muhlenbergia montana</i> H.T. [ <i>P. ponderosa</i> / <i>Poa longiligula</i> C.T.]	Mountains of Arizona and New Mexico	Warm dry	<i>P. ponderosa</i> climax	<i>P. edulis</i> <i>Juniperus</i> spp.	<i>M. montana</i> <i>Berberis repens</i> <i>Q. gambelii</i> <i>B. gracilis</i> <i>P. fendleriana</i> <i>P. longiligula</i> <i>Sitanion hystrix</i> <i>Senecio neomexicana</i>	Alexander et al. 1987 DeVelice et al. 1986 Fitzhugh et al. 1987 Hanks et al. 1983 Muldavin et al. <sup>1</sup>
<i>Pinus ponderosa</i> <i>Muhlenbergia virescens</i> H.T. [ <i>P. ponderosa</i> / <i>M. virescens</i> - <i>Festuca arizonica</i> H.T.] [ <i>P. ponderosa</i> / <i>M. virescens</i> - <i>F. arizonica</i> - <i>Bouteloua gracilis</i> C.T.] <i>M. virescens</i> (typic) phase <i>Quercus gambelii</i> phase <i>M. virescens</i> - <i>F. arizonica</i> phase <i>Bouteloua gracilis</i> phase	Mountains of Arizona and New Mexico	Warm dry	<i>P. ponderosa</i> climax	<i>P. edulis</i> <i>P. strobiformis</i> <i>P. menziesii</i> <i>J. deppeana</i>	<i>M. virescens</i> <i>B. repens</i> <i>C. fendleri</i> <i>Quercus</i> spp. <i>B. gracilis</i> <i>F. arizonica</i> <i>M. montana</i> <i>Poa</i> spp. <i>Carex</i> spp. <i>Senecio wootonii</i>	Alexander et al. 1987 DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Hanks et al. 1983 Muldavin et al. <sup>1</sup>
<i>Pinus ponderosa</i> <i>Oryzopsis hymenoides</i> H.T. (Sand hills)	Mountains of northern New Mexico	Warm very dry	<i>P. ponderosa</i> climax	<i>J. monosperma</i>	<i>Q. hymenoides</i> <i>S. scoparium</i> <i>Polioimntha incana</i>	DeVelice et al. 1986
<i>Pinus ponderosa</i> <i>Poa pratensis</i> H.T. [ <i>Pinus ponderosa</i> / Riparian H.T.]	Mountains of central and northern New Mexico	Warm moist	<i>P. ponderosa</i> climax	<i>Populus angustifolia</i> <i>Acer negundo</i> <i>Alnus tenuifolia</i>	<i>P. pratensis</i> <i>Galium</i> spp. <i>Iris missouriensis</i> <i>Juncus</i> spp.	Alexander et al. 1987 DeVelice et al. 1986
<i>Pinus ponderosa</i> Cinder Soils H.T. <i>Bouteloua gracilis</i> - <i>Andropogon hallii</i> phase	Mountains of north-central and northwestern New Mexico	Warm dry	<i>P. ponderosa</i> climax	<i>P. edulis</i>	<i>Q. gambelii</i> <i>R. cereum</i> <i>A. hallii</i> <i>B. gracilis</i> <i>M. montana</i> <i>Lupinus</i> spp.	Alexander et al. 1987

<i>Pinus ponderosa</i> Rockland H.T.	Mountains of western New Mexico	Warm dry	<i>P. ponderosa</i> climax	<i>P. strobiformis</i> <i>P. menziesii</i> <i>P. edulis</i> <i>J. deppeana</i>	<i>Q. grisea</i> <i>Bouteloua</i> spp. <i>M. montana</i> <i>M. virescens</i> <i>Solidago</i> spp.	Alexander et al. 1987 Fitzhugh et al. 1987
<i>Pinus flexilis</i> series						
<i>Pinus flexilis</i> <i>Arctostaphylos uva-ursi</i> H.T.	Mountains of northern New Mexico	Warm dry	<i>P. flexilis</i> <sup>3</sup> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>Picea engelmannii</i> (minor climax) <i>Populus tremuloides</i>	<i>A. uva-ursi</i> <i>Juniperus communis</i>	DeVelice et al. 1986
<i>Pinus strobiformis</i> series						
<i>Pinus strobiformis</i> <i>Festuca arizonica</i> H.T.	Mountains of northern Arizona	Warm dry	<i>P. strobiformis</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. ponderosa</i>	<i>F. arizonica</i> <i>Muhlenbergia</i> spp.	Moir and Ludwig 1979
<i>Pseudotsuga menziesii</i> series						
<i>Pseudotsuga menziesii</i> <i>Acer grandidentatum</i> H.T.	Galiuro Mountains, southeastern Arizona	Warm moist	<i>P. menziesii</i> climax	<i>Abies concolor</i> <i>P. ponderosa</i> <i>P. strobiformis</i>	<i>A. grandidentatum</i> <i>Holodiscus dumosus</i> <i>Q. gambelii</i>	DeVelice and Ludwig <sup>2</sup>
<i>Pseudotsuga menziesii</i> <i>Arctostaphylos uva-ursi</i> H.T.	San Mateo Mountains, New Mexico	Warm very dry	<i>P. menziesii</i> climax	<i>P. strobiformis</i>	<i>A. uva-ursi</i> <i>Bromus ciliatus</i>	Fitzhugh et al. 1987
<i>Pseudotsuga menziesii</i> <i>Holodiscus dumosus</i> H.T. (Scree forest)	Mountains of New Mexico	Warm dry	<i>P. menziesii</i> climax	<i>P. strobiformis</i> <i>P. flexilis</i> <i>P. engelmannii</i> <i>Abies lasiocarpa</i> <i>P. tremuloides</i>	<i>H. dumosus</i> <i>Cercocarpus montanus</i> <i>Jamesia americana</i> <i>Ribes</i> spp. <i>Salix scouleriana</i> <i>Symphoricarpos</i> <i>oreophilus</i>	DeVelice et al. 1986 Fitzhugh et al. 1987
<i>Pseudotsuga menziesii</i> <i>Quercus arizonica</i> H.T.	Bradshaw and Sierra Ancha Mountains, Arizona	Warm dry	<i>P. menziesii</i> co-climax with <i>P. ponderosa</i>	<i>P. ponderosa</i> <i>J. deppeana</i>	<i>Q. arizonica</i> <i>Q. gambelii</i> <i>M. longiligula</i>	DeVelice and Ludwig <sup>2</sup> Muldavin et al. <sup>1</sup>
<i>Pseudotsuga menziesii</i> <i>Quercus gambelii</i> H.T. <i>Q. gambelii</i> (typic) phase <i>Holodiscus dumosus</i> phase <i>Festuca arizonica</i> phase <i>Muhlenbergia virescens</i> phase	Mountains of New Mexico and Arizona	Warm dry	<i>P. menziesii</i> climax	<i>P. ponderosa</i> <i>P. strobiformis</i> <i>P. edulis</i> <i>J. deppeana</i> <i>J. scopulorum</i>	<i>Q. gambelii</i> <i>H. dumosus</i> <i>S. oreophilus</i> <i>F. arizonica</i> <i>M. montana</i> <i>M. virescens</i> <i>C. rossii</i>	Alexander et al. 1984a, 1984b, 1987 DeVelice et al. 1986 DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Muldavin et al. <sup>1</sup>
<i>Pseudotsuga menziesii</i> <i>Quercus hypoleucoides</i> H.T.	Mountains of southern Arizona and southwestern New Mexico	Warm to hot, dry	<i>P. menziesii</i> climax	<i>P. ponderosa</i> <i>P. strobiformis</i> <i>A. concolor</i>	<i>Q. hypoleucoides</i> <i>Agave</i> spp. <i>Q. arizonica</i> <i>Q. rugosa</i> <i>Opuntia</i> spp. <i>M. longiligula</i> <i>P. fendleriana</i>	DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Moir and Ludwig 1979 Muldavin et al. <sup>1</sup>
<i>Pseudotsuga menziesii</i> <i>Quercus rugosa</i> H.T.	Mountains of south-central Arizona	Warm dry	<i>P. menziesii</i> climax	<i>P. ponderosa</i> <i>P. strobiformis</i>	<i>Q. rugosa</i> <i>Quercus</i> spp.	DeVelice and Ludwig <sup>2</sup> Muldavin et al. <sup>1</sup>
<i>Pseudotsuga menziesii</i> <i>Bromus ciliatus</i> H.T.	Mountains of New Mexico	Cool moist to wet	<i>P. menziesii</i> climax	<i>P. ponderosa</i> (minor climax) <i>P. strobiformis</i> <i>P. tremuloides</i>	<i>B. ciliatus</i> <i>Acer glabrum</i> <i>P. fendleriana</i> <i>Erigeron eximius</i> ( <i>E. superbus</i> )	Alexander et al. 1987 Fitzhugh et al. 1987
<i>Pseudotsuga menziesii</i> <i>Festuca arizonica</i> H.T.	Mountains of New Mexico and Arizona	Warm dry	<i>P. menziesii</i> climax	<i>P. ponderosa</i> <i>P. strobiformis</i> <i>P. flexilis</i> <i>Pinus aristata</i> <i>P. tremuloides</i>	<i>F. arizonica</i> <i>A. uva-ursi</i> <i>H. dumosus</i> <i>Q. gambelii</i> <i>B. ciliatus</i> <i>Koeleria cristata</i> ( <i>K. macrantha</i> ) <i>P. fendleriana</i> <i>M. montana</i>	Alexander et al. 1984b, 1987 DeVelice et al. 1986 Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Pseudotsuga menziesii</i> <i>Muhlenbergia montana</i> H.T.	Mountains of New Mexico and eastern Arizona	Warm dry	<i>P. menziesii</i> co-climax with <i>P. ponderosa</i>	<i>P. ponderosa</i> <i>P. strobiformis</i> <i>Juniperus</i> spp.	<i>M. montana</i> <i>B. repens</i> <i>Q. gambelii</i> <i>P. fendleriana</i>	Alexander et al. 1987 Fitzhugh et al. 1987
<i>Pseudotsuga menziesii</i> <i>Muhlenbergia virescens</i> H.T. [ <i>P. menziesii</i> - <i>Pinus strobiformis</i> / <i>M. virescens</i> H.T.]	Mountains of New Mexico and Arizona	Warm dry	<i>P. menziesii</i> co-climax with <i>P. ponderosa</i> <i>P. strobiformis</i>	<i>P. ponderosa</i> <i>P. strobiformis</i> <i>P. tremuloides</i>	<i>M. virescens</i> <i>C. fendleri</i> <i>Q. gambelii</i> <i>B. ciliatus</i> <i>P. fendleriana</i> <i>C. rossii</i>	Alexander et al. 1984b DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Moir and Ludwig 1979 Muldavin et al. <sup>1</sup>
<i>Pseudotsuga menziesii</i> Sparse H.T. [ <i>P. menziesii</i> <i>Berberis repens</i> H.T.]	Mountains of northern Arizona	Warm dry	<i>P. menziesii</i> climax	<i>P. ponderosa</i> <i>P. strobiformis</i>	<i>B. repens</i> <i>Bromus richardsonii</i> <i>P. fendleriana</i> (sparse)	Alexander et al. 1984b



*Abies concolor* series

<i>Abies concolor</i> <i>Acer glabrum</i> H.T. [ <i>A. concolor</i> - <i>Pseudotsuga menziesii</i> <i>A. glabrum</i> H.T.] <i>A. glabrum</i> (typic) phase <i>Berberis repens</i> phase <i>Holodiscus dumosus</i> phase <i>Pachistima myrsinites</i> phase Riparian phase	Mountains of New Mexico and Arizona	Cool moist to well- drained	<i>A. concolor</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. strobiliformis</i> <i>P. flexilis</i> <i>P. ponderosa</i> <i>Picea pungens</i> <i>P. engelmannii</i> <i>P. tremuloides</i>	<i>A. glabrum</i> <i>Amelanchier alnifolia</i> <i>B. repens</i> <i>H. dumosus</i> <i>Pachistima myrsinites</i> <i>Prunus virginiana</i> <i>Q. gambelii</i> <i>B. ciliatus</i> <i>Geranium richardsonii</i>	Alexander et al. 1984a, 1987 DeVelice et al. 1986 DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Moir and Ludwig 1979 Muldavin et al. <sup>1</sup>
<i>Abies concolor</i> <i>Acer grandidentatum</i> H.T. <i>A. grandidentatum</i> (typic) phase <i>Holodiscus dumosus</i> phase	Mountains of Arizona and New Mexico	Cool moist to warm well-drained	<i>A. concolor</i> climax or co-climax with <i>P. menziesii</i>	<i>P. ponderosa</i> (AZ) <i>P. strobiliformis</i> <i>P. menziesii</i> <i>P. tremuloides</i>	<i>A. grandidentatum</i> <i>H. dumosus</i> <i>J. major</i> <i>Q. gambelii</i> <i>Carex foenea</i> <i>Thalictrum fendleri</i>	Alexander et al. 1984a DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Moir and Ludwig 1979 Muldavin et al. <sup>1</sup>
<i>Abies concolor</i> <i>Arctostaphylos uva-ursi</i> H.T.	Mountains of northern New Mexico	Warm dry	<i>A. concolor</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. ponderosa</i> <i>P. flexilis</i> <i>P. tremuloides</i>	<i>A. uva-ursi</i> <i>P. myrsinites</i>	DeVelice et al. 1986
<i>Abies concolor</i> <i>Holodiscus dumosus</i> H.T. (Scree forest)	Mountains of New Mexico	Cool dry	<i>A. concolor</i> co-climax with <i>P. menziesii</i> <i>P. strobiliformis</i>	<i>P. menziesii</i> <i>P. strobiliformis</i> <i>P. ponderosa</i> <i>P. tremuloides</i> <i>P. flexilis</i>	<i>H. dumosus</i> <i>J. americana</i> <i>Ribes</i> spp. <i>B. ciliatus</i> <i>K. cristata</i> ( <i>K. macrantha</i> ) <i>P. fendleriana</i>	DeVelice et al. 1986 Fitzhugh et al. 1987
<i>Abies concolor</i> <i>Juglans major</i> H.T.	Mountains of southern New Mexico; Canyon Creek, Arizona	Warm moist	<i>A. concolor</i> climax	<i>P. menziesii</i> <i>P. tremuloides</i> <i>P. angustifolia</i> <i>Fraxinus pennsylvanica</i>	<i>J. major</i> <i>Q. gambelii</i> <i>P. pratensis</i> <i>T. fendleri</i> <i>V. arizonica</i>	Alexander et al. 1984a Fitzhugh et al. 1987 Muldavin et al. <sup>1</sup>
<i>Abies concolor</i> <i>Quercus gambelii</i> H.T. [ <i>A. concolor</i> - <i>Pseudotsuga menziesii</i> <i>Q. gambelii</i> H.T.] <i>Q. gambelii</i> (typic) phase <i>Holodiscus dumosus</i> phase <i>Festuca arizonica</i> phase <i>Muhlenbergia dubia</i> phase <i>Muhlenbergia virescens</i> phase	Mountains of New Mexico and Arizona	Warm dry	<i>A. concolor</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. ponderosa</i> <i>P. strobiliformis</i> <i>P. flexilis</i> <i>P. tremuloides</i> <i>J. deppeana</i> <i>J. scopulorum</i>	<i>Q. gambelii</i> <i>H. dumosus</i> <i>S. oreophilus</i> <i>F. arizonica</i> <i>M. dubia</i> <i>M. virescens</i> <i>L. arizonicus</i> <i>T. fendleri</i>	Alexander et al. 1984a, 1987 DeVelice et al. 1986 DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Moir and Ludwig 1979 Muldavin et al. <sup>1</sup>
<i>Abies concolor</i> <i>Robinia neomexicana</i> H.T. <i>R. neomexicana</i> (typic) phase <i>Carex foenea</i> phase	Mountains of eastern Arizona and western New Mexico	Warm dry	<i>A. concolor</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. strobiliformis</i> <i>P. ponderosa</i> <i>P. engelmannii</i> <i>P. tremuloides</i>	<i>R. neomexicana</i> <i>Q. gambelii</i> <i>Rubus</i> spp. <i>C. foenea</i> <i>G. richardsonii</i>	Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Abies concolor</i> <i>Vaccinium myrtillus</i> H.T.	Mountains of northern New Mexico	Cool dry	<i>A. concolor</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. pungens</i> <i>P. engelmannii</i> <i>A. lasiocarpa</i> <i>P. tremuloides</i>	<i>V. myrtillus</i> <i>A. glabrum</i> <i>A. uva-ursi</i> <i>P. myrsinites</i> <i>Rubus parviflorus</i>	DeVelice et al. 1986
<i>Abies concolor</i> <i>Elymus triticoides</i> H.T. [ <i>A. concolor</i> - <i>Pseudotsuga menziesii</i> <i>E. triticoides</i> H.T.]	Capitan Mountains, New Mexico	Warm dry	<i>A. concolor</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. ponderosa</i> <i>P. strobiliformis</i> <i>P. tremuloides</i>	<i>E. triticoides</i> <i>H. dumosus</i> <i>Q. gambelii</i> <i>B. richardsonii</i> <i>M. montana</i>	Alexander et al. 1984a Moir and Ludwig 1979
<i>Abies concolor</i> <i>Festuca arizonica</i> H.T. [ <i>A. concolor</i> - <i>Pseudotsuga menziesii</i> <i>P. fendleriana</i> H.T.] <i>F. arizonica</i> (typic) phase <i>Quercus gambelii</i> phase <i>Poa fendleriana</i> phase	Northern mountains of Arizona and New Mexico	Warm dry	<i>A. concolor</i> climax or co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. ponderosa</i> <i>P. strobiliformis</i> <i>P. flexilis</i> <i>P. tremuloides</i>	<i>F. arizonica</i> <i>Q. gambelii</i> <i>M. montana</i> <i>P. fendleriana</i> <i>Erigeron</i> spp. <i>Fragaria americana</i> ( <i>F. vesca</i> )	DeVelice et al. 1986 Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Abies concolor</i> <i>Muhlenbergia virescens</i> H.T.	Mountains of eastern Arizona and southwestern New Mexico	Warm dry	<i>A. concolor</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. strobiliformis</i> <i>P. ponderosa</i> <i>P. tremuloides</i>	<i>M. virescens</i> <i>B. ciliatus</i> <i>P. fendleriana</i> <i>C. rossii</i> <i>Lupinus argenteus</i> <i>Senecio</i> spp.	Fitzhugh et al. 1987
<i>Abies concolor</i> <i>Carex foenea</i> H.T.	Pinaleno and Santa Catalina Mountains, Arizona	Warm moist	<i>A. concolor</i> climax	<i>P. menziesii</i> <i>P. ponderosa</i> <i>P. strobiliformis</i>	<i>C. foenea</i> <i>B. ciliatus</i> <i>P. pratensis</i>	DeVelice and Ludwig <sup>2</sup> Moir and Ludwig 1979 Muldavin et al. <sup>1</sup>

<i>Abies concolor</i> <i>Erigeron eximius</i> H.T. [ <i>A. concolor</i> - <i>Pseudotsuga menziesii</i> <i>E. superbus</i> H.T.]	Mountains of New Mexico and Arizona	Cool moist	<i>A. concolor</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. strobiliformis</i> <i>P. flexilis</i> <i>P. pungens</i> <i>P. engelmannii</i> <i>P. tremuloides</i>	<i>E. superbus</i> ( <i>E. eximius</i> ) <i>B. ciliatus</i> <i>C. foenea</i> <i>Fragaria ovalis</i> ( <i>F. virginiana</i> ) <i>Haplopappus parryi</i> <i>Lathyrus arizonicus</i>	DeVelice et al. 1986 Fitzhugh et al. 1987 Moir and Ludwig 1979 Muldavin et al. <sup>1</sup>
<i>Abies concolor</i> <i>Galium triflorum</i> H.T. (Riparian forest)	Mountains of northern New Mexico	Cool moist	<i>A. concolor</i> climax	<i>P. menziesii</i> <i>J. scopulorum</i> <i>P. angustifolia</i> <i>A. tenuifolia</i>	<i>G. triflorum</i> <i>A. glabrum</i> <i>Q. gambelii</i> <i>P. virginiana</i> <i>T. fendleri</i>	DeVelice et al. 1986
<i>Abies concolor</i> - <i>Pseudotsuga menziesii</i> <i>Lathyrus arizonicus</i> H.T.	San Francisco Peaks, Arizona	Cool dry	<i>A. concolor</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. ponderosa</i> <i>P. tremuloides</i>	<i>L. arizonicus</i> <i>G. richardsonii</i>	Moir and Ludwig 1979
<i>Abies concolor</i> Sparse H.T. [ <i>A. concolor</i> - <i>Pseudotsuga menziesii</i> H.T.] <i>Berberis repens</i> phase <i>Robina neomexicana</i> phase	Mountains of New Mexico and Arizona	Warm dry	<i>A. concolor</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>P. ponderosa</i> <i>P. strobiliformis</i> <i>P. flexilis</i> <i>P. pungens</i> <i>P. tremuloides</i>	<i>S. oreophilus</i> <i>B. repens</i> <i>Q. gambelii</i> <i>R. neomexicana</i> <i>B. ciliatus</i> (sparse)	Alexander et al. 1984a DeVelice et al. 1986 DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Moir and Ludwig 1979 Muldavin et al. <sup>1</sup>
<i>Picea pungens</i> series						
<i>Picea pungens</i> <i>Arctostaphylos uva-ursi</i> H.T.	Mountains of northern New Mexico	Warm dry	<i>P. pungens</i> co-climax with <i>P. menziesii</i> <i>A. concolor</i>	<i>P. menziesii</i> <i>A. concolor</i> <i>P. ponderosa</i> <i>P. strobiliformis</i> <i>P. flexilis</i> <i>P. tremuloides</i>	<i>A. uva-ursi</i> <i>J. communis</i> <i>F. arizonica</i> <i>F. ovalis</i> ( <i>F. virginiana</i> )	DeVelice et al. 1986
<i>Picea pungens</i> - <i>Pseudotsuga menziesii</i> H.T. <i>Arctostaphylos uva-ursi</i> phase <i>Juniperus communis</i> phase <i>Valeriana acutiloba</i> phase	Mountains of New Mexico and Arizona	Warm dry	<i>P. pungens</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>A. concolor</i> <i>P. strobiliformis</i> <i>P. tremuloides</i>	<i>A. uva-ursi</i> <i>J. communis</i> <i>P. myrsinites</i> <i>E. eximius</i> ( <i>E. superbus</i> ) <i>L. arizonica</i> <i>V. acutiloba</i>	Moir and Ludwig 1979
<i>Picea pungens</i> <i>Cornus stolonifera</i> H.T. [ <i>P. pungens</i> <i>Swida sericea</i> H.T.] (Riparian forest)	Mountains of north-central and northwestern New Mexico	Warm moist	<i>P. pungens</i> co-climax with <i>P. menziesii</i>	<i>A. concolor</i> <i>P. menziesii</i> <i>Juniperus</i> spp. <i>P. tremuloides</i> <i>P. angustifolia</i> <i>A. tenuifolia</i>	<i>C. stolonifera</i> <i>B. repens</i> <i>P. myrsinites</i> <i>C. foenea</i> <i>S. sericea</i> <i>G. trifolium</i> <i>G. richardsonii</i> <i>Smilacina stellata</i>	Alexander et al. 1987 DeVelice et al. 1986
<i>Picea pungens</i> <i>Linnaea borealis</i> H.T. [ <i>P. pungens</i> - <i>Pseudotsuga menziesii</i> H.T.] <i>L. borealis</i> phase	Mountains of southern Colorado and northern New Mexico	Cool well- drained	<i>P. pungens</i> co-climax with <i>P. menziesii</i> <i>A. concolor</i>	<i>P. menziesii</i> <i>A. concolor</i> <i>P. strobiliformis</i> <i>P. flexilis</i> <i>P. engelmannii</i> <i>A. lasiocarpa</i> <i>P. tremuloides</i>	<i>L. borealis</i> <i>P. myrsinites</i> <i>Vaccinium myrtillus</i> <i>R. parviflorus</i>	DeVelice et al. 1986 Moir and Ludwig 1979
<i>Picea pungens</i> <i>Festuca arizonica</i> H.T.	Mountains of northern and western New Mexico, and eastern Arizona	Cool dry	<i>P. pungens</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>A. concolor</i> <i>P. ponderosa</i> <i>P. strobiliformis</i> <i>P. tremuloides</i>	<i>F. arizonica</i> <i>M. montana</i> <i>C. foenea</i> <i>Erigeron</i> spp. <i>Fragaria</i> spp.	DeVelice et al. 1986 Fitzhugh et al. 1987
<i>Picea pungens</i> <i>Poa pratensis</i> H.T. (Riparian forest)	Mountains of New Mexico	Warm to cool moist	<i>P. pungens</i> climax	<i>P. menziesii</i> <i>A. concolor</i> <i>P. ponderosa</i> <i>P. strobiliformis</i> <i>P. tremuloides</i>	<i>P. pratensis</i> <i>E. superbus</i> ( <i>E. eximius</i> ) <i>G. richardsonii</i> <i>F. ovalis</i> ( <i>F. virginiana</i> )	DeVelice et al. 1986 Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Picea pungens</i> <i>Carex foenea</i> H.T.	White and Blue Mountains, and Kaibab Plateau, Arizona; mountains of northern New Mexico	Warm to cool moist	<i>P. pungens</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>A. concolor</i> <i>P. ponderosa</i> <i>P. strobiliformis</i> <i>P. engelmannii</i> <i>P. tremuloides</i>	<i>C. foenea</i> <i>B. repens</i> <i>B. ciliatus</i> <i>Festuca</i> spp. <i>M. montana</i> <i>Fragaria</i> spp. <i>G. richardsonii</i>	Alexander et al. 1987 DeVelice et al. 1986 Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Picea pungens</i> <i>Erigeron eximius</i> H.T. [ <i>P. pungens</i> - <i>Picea engelmannii</i> <i>Erigeron superbus</i> H.T.] <i>E. eximius</i> (typic) phase <i>Pinus ponderosa</i> phase	Mountains of western and northern New Mexico, and eastern Arizona	Cool moist	<i>P. pungens</i> co-climax with <i>A. concolor</i> <i>P. menziesii</i>	<i>A. concolor</i> <i>P. menziesii</i> <i>P. engelmannii</i> <i>P. ponderosa</i> <i>P. strobiliformis</i> <i>P. flexilis</i> <i>P. tremuloides</i>	<i>E. eximius</i> ( <i>E. superbus</i> ) <i>B. ciliatus</i> <i>C. foenea</i> <i>G. richardsonii</i> <i>F. americana</i> ( <i>F. vesca</i> ) <i>H. parryi</i> <i>T. fendleri</i>	DeVelice et al. 1986 Fitzhugh et al. 1987 Moir and Ludwig 1979



<i>Picea pungens</i> <i>Fragaria ovalis</i> H.T.	Mountains of southern New Mexico	Cool moist	<i>P. pungens</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i> <i>A. concolor</i> <i>P. strobiformis</i> <i>P. engelmannii</i> <i>P. tremuloides</i>	<i>F. ovalis</i> ( <i>F. virginiana</i> ) <i>F. americana</i> ( <i>F. vesca</i> ) <i>A. glabrum</i> <i>H. dumosus</i> <i>B. richardsonii</i> <i>P. pratensis</i>	Alexander et al. 1984a
<i>Picea pungens</i> <i>Senecio cardamine</i> H.T. [ <i>P. pungens</i> - <i>Picea engelmannii</i> <i>S. cardamine</i> H.T.]	White and Blue Mountains, Arizona; Mogollon Mountains, New Mexico	Cool moist	<i>P. pungens</i> co-climax with <i>A. lasiocarpa</i> <i>P. engelmannii</i>	<i>A. lasiocarpa</i> <i>P. engelmannii</i> <i>P. ponderosa</i> <i>P. strobiformis</i> <i>P. menziesii</i> <i>A. concolor</i> <i>P. tremuloides</i>	<i>S. cardamine</i> <i>Helenium hoopesii</i> <i>Pteridium aquilinum</i> <i>Viola canadensis</i>	Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Abies lasiocarpa</i> series						
<i>Abies lasiocarpa</i> <i>Acer glabrum</i> H.T.	Mountains of north-central and northwestern New Mexico	Warm moist	<i>A. lasiocarpa</i> climax	<i>P. engelmannii</i> <i>P. menziesii</i> <i>A. concolor</i> <i>P. tremuloides</i>	<i>A. glabrum</i> <i>B. repens</i> <i>S. oreophyllus</i> <i>B. ciliatus</i> <i>E. eximius</i> ( <i>E. superbus</i> )	Alexander et al. 1987
<i>Abies lasiocarpa</i> <i>Holodiscus dumosus</i> H.T. (Scree forest)	Mogollon Mountains, New Mexico	Warm dry	<i>A. lasiocarpa</i> climax or co-climax with <i>P. strobiformis</i> <i>P. menziesii</i>	<i>P. strobiformis</i> <i>P. menziesii</i> <i>P. engelmannii</i>	<i>H. dumosus</i> <i>J. communis</i> <i>R. neomexicana</i> <i>S. oreophyllus</i> <i>G. richardsonii</i>	Fitzhugh et al. 1987
<i>Abies lasiocarpa</i> <i>Jamesia americana</i> H.T. (Scree forest)	Santa Catalina Mountains, Arizona	Cool dry	<i>A. lasiocarpa</i> climax	<i>P. menziesii</i>	<i>J. americana</i> <i>Ribes pinetorum</i> <i>Sambucus melanocarpa</i> <i>S. oreophyllus</i>	Muldavin et al. <sup>1</sup>
<i>Abies lasiocarpa</i> <i>Juniperus communis</i> H.T.	Mountains of northern Arizona and New Mexico	Cool dry	<i>A. lasiocarpa</i> co-climax with <i>P. engelmannii</i>	<i>P. engelmannii</i> <i>P. menziesii</i> <i>A. concolor</i> <i>P. tremuloides</i>	<i>J. communis</i> <i>Pyrola secunda</i>	Moir and Ludwig 1979
<i>Abies lasiocarpa</i> <i>Rubus parviflorus</i> H.T.	Mimbres and Mogollon Mountains, New Mexico	Warm well- drained	<i>A. lasiocarpa</i> co-climax with <i>P. engelmannii</i>	<i>P. engelmannii</i> <i>P. menziesii</i> <i>A. concolor</i> <i>P. tremuloides</i>	<i>R. parviflorus</i> <i>A. glabrum</i> <i>P. myrsinites</i> <i>B. ciliatus</i> <i>E. eximius</i> ( <i>E. superbus</i> ) <i>G. richardsonii</i>	DeVelice et al. 1986 Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Abies lasiocarpa</i> <i>Vaccinium myrtillus</i> H.T. [ <i>A. lasiocarpa</i> /V. <i>myrtillus</i> - <i>Linnaea borealis</i> H.T.] [ <i>A. lasiocarpa</i> /V. <i>myrtillus</i> - <i>Rubus parviflorus</i> H.T.] [ <i>A. lasiocarpa</i> / <i>Vaccinium scoparium</i> - <i>L. borealis</i> H.T.] [ <i>A. lasiocarpa</i> / <i>V. scoparium</i> H.T.] <i>V. myrtillus</i> (typic) phase <i>R. parviflorus</i> phase	Mountains of northern and central Arizona; mountains of northern New Mexico	Cool moist to well- drained	<i>A. lasiocarpa</i> climax or co-climax with <i>P. engelmannii</i>	<i>P. engelmannii</i> <i>P. menziesii</i> <i>A. concolor</i> <i>P. strobiformis</i> <i>P. flexilis</i> <i>P. aristata</i> <i>P. tremuloides</i>	<i>V. myrtillus</i> <i>L. borealis</i> <i>R. parviflorus</i> <i>V. scoparium</i> <i>E. eximius</i> ( <i>E. superbus</i> ) <i>Pedicularis racemosa</i> <i>Ramischia secunda</i>	Alexander et al. 1987 DeVelice et al. 1986 DeVelice and Ludwig <sup>2</sup> Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Abies lasiocarpa</i> <i>Erigeron eximius</i> H.T. [ <i>A. lasiocarpa</i> / <i>Erigeron superbus</i> H.T.]	Mountains of northern New Mexico and Arizona	Cool moist	<i>A. lasiocarpa</i> co-climax with <i>P. engelmannii</i>	<i>P. engelmannii</i> <i>P. menziesii</i> <i>A. concolor</i> <i>P. pungens</i> <i>P. strobiformis</i> <i>P. tremuloides</i>	<i>E. eximius</i> ( <i>E. superbus</i> ) <i>Lonicera involucrata</i> <i>Arnica cordifolia</i> <i>G. richardsonii</i> <i>L. arizonicus</i>	Alexander et al. 1987 DeVelice et al. 1986 Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Abies lasiocarpa</i> <i>Lathyrus arizonicus</i> H.T.	San Francisco Peaks, Arizona; Mogollon Mountains, New Mexico	Cool dry	<i>A. lasiocarpa</i> climax	<i>P. engelmannii</i> <i>P. menziesii</i> <i>P. strobiformis</i> <i>P. tremuloides</i>	<i>L. arizonicus</i> <i>A. glabrum</i> <i>S. oreophyllus</i> <i>B. ciliatus</i> <i>G. richardsonii</i> <i>S. stellata</i> <i>Vicia americana</i>	Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Abies lasiocarpa</i> <i>Mertensia ciliata</i> H.T.	Mountains of northern New Mexico	Cool wet	<i>A. lasiocarpa</i> co-climax with <i>P. engelmannii</i>	<i>P. engelmannii</i> <i>P. tremuloides</i>	<i>M. ciliata</i> <i>Carex bella</i> <i>Caltha leptosepala</i> <i>Cardamine cordifolia</i> <i>Mitella pentandra</i> <i>Oxypolis fendleri</i>	DeVelice et al. 1986
<i>Abies lasiocarpa</i> <i>Saxifraga bronchialis</i> H.T. (Scree forest)	Mountains of northern New Mexico	Cool to warm dry	<i>A. lasiocarpa</i> climax	<i>P. engelmannii</i> <i>P. menziesii</i>	<i>S. bronchialis</i> <i>J. communis</i> <i>Ribes montigenum</i> <i>C. rossii</i> <i>K. cristata</i> ( <i>K. macrantha</i> ) <i>F. ovalis</i> ( <i>F. virginiana</i> )	DeVelice et al. 1986



<i>Abies lasiocarpa</i> <i>Senecio sanguisorboides</i> H.T. <i>S. sanguisorboides</i> (typic) phase <i>Pseudotsuga menziesii</i> phase	Sacramento Mountains, southern New Mexico	Cool dry to well-drained	<i>A. lasiocarpa</i> co-climax with <i>P. engelmannii</i>	<i>P. engelmannii</i> <i>P. menziesii</i> <i>P. tremuloides</i>	<i>S. sanguisorboides</i> <i>R. montigenum</i> <i>Ribes wolfii</i> <i>G. richardsonii</i>	Alexander et al. 1984a Moir and Ludwig 1979
<i>Abies lasiocarpa</i> Moss H.T.	Mountains of northern New Mexico; Pinaleno Mountains, Arizona	Cool dry	<i>A. lasiocarpa</i> co-climax with <i>P. engelmannii</i>	<i>P. engelmannii</i> <i>P. menziesii</i> <i>P. aristata</i> <i>P. tremuloides</i>	Moss spp. <i>A. glabrum</i> <i>J. communis</i> <i>Vaccinium caespitosum</i>	DeVelice et al. 1986 DeVelice and Ludwig <sup>2</sup>
<i>Picea engelmannii</i> series						
<i>Picea engelmannii</i> <i>Acer glabrum</i> H.T.	Chiricahua Mountains, Arizona; Sacramento Mountains, New Mexico	Cool moist	<i>P. engelmannii</i> climax	<i>P. menziesii</i> <i>A. lasiocarpa</i> (absent AZ) <i>A. concolor</i> <i>P. tremuloides</i>	<i>A. glabrum</i> <i>B. ciliatus</i> <i>Ligusticum porteri</i> <i>S. stellata</i> <i>V. canadensis</i>	Alexander et al. 1984a DeVelice and Ludwig <sup>2</sup> Moir and Ludwig 1979
<i>Picea engelmannii</i> <i>Vaccinium myrtillus</i> H.T. [ <i>P. engelmannii</i> <i>V. myrtillus</i> - <i>Polemonium pulcherrimum</i> H.T.] [ <i>P. engelmannii</i> <i>Vaccinium scoparium</i> - <i>P. delicatum</i> H.T.] <i>P. engelmannii</i> phase <i>Abies lasiocarpa</i> phase	Mountains of northern and western New Mexico	Cool dry to well-drained	<i>P. engelmannii</i> climax or co-climax with <i>A. lasiocarpa</i>	<i>A. lasiocarpa</i> <i>P. aristata</i> <i>P. tremuloides</i>	<i>V. myrtillus</i> <i>J. americana</i> <i>J. communis</i> <i>V. scoparium</i> <i>P. delicatum</i> ( <i>P. pulcherrimum</i> ) <i>Senecio amplexans</i>	DeVelice et al. 1986 Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Picea engelmannii</i> <i>Elymus triticoides</i> H.T.	Capitan Mountains, New Mexico	Cool dry to well-drained	<i>P. engelmannii</i> climax or co-climax with <i>A. lasiocarpa</i>	<i>A. lasiocarpa</i> <i>P. menziesii</i> <i>P. tremuloides</i>	<i>E. triticoides</i> <i>A. glabrum</i> <i>J. americana</i> <i>Ribes</i> spp.	Alexander et al. 1984a Moir and Ludwig 1979
<i>Picea engelmannii</i> <i>Carex foenea</i> H.T.	Pinaleno Mountains, Arizona	Cool dry	<i>P. engelmannii</i> climax	Generally in pure stands	<i>C. foenea</i>	DeVelice and Ludwig <sup>2</sup> Moir and Ludwig 1979
<i>Picea engelmannii</i> <i>Erigeron eximius</i> H.T. [ <i>Picea pungens</i> - <i>P. engelmannii</i> <i>Erigeron superbus</i> H.T.] <i>E. eximius</i> (typic) phase <i>P. pungens</i> phase	Mountains of eastern Arizona and New Mexico	Cool well-drained	<i>P. engelmannii</i> climax or co-climax with <i>P. menziesii</i> <i>P. pungens</i>	<i>A. lasiocarpa</i> <i>A. concolor</i> <i>P. pungens</i> <i>P. menziesii</i> <i>P. ponderosa</i> <i>P. strobiformis</i> <i>P. tremuloides</i>	<i>E. eximius</i> ( <i>E. superbus</i> ) <i>B. ciliatus</i> <i>L. arizonicus</i> <i>S. stellata</i> <i>V. canadensis</i>	Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Picea engelmannii</i> <i>Geum rossii</i> H.T.	San Francisco Peaks, Arizona	Cool dry	<i>P. engelmannii</i> climax	<i>P. tremuloides</i>	<i>G. rossii</i> <i>Festuca brachyphylla</i> <i>P. delicatum</i> ( <i>P. pulcherrimum</i> )	Moir and Ludwig 1979
<i>Picea engelmannii</i> <i>Heracleum spondylium</i> H.T. (Riparian forest)	Mountains of northern New Mexico	Cool moist	<i>P. engelmannii</i> climax	<i>P. angustifolia</i> <i>A. tenuifolia</i>	<i>H. spondylium</i> <i>G. richardsonii</i> <i>M. ciliata</i> <i>T. fendleri</i> <i>V. canadensis</i>	DeVelice et al. 1986
<i>Picea engelmannii</i> <i>Saxifraga bronchialis</i> H.T. (Scree forest)	Mountains of northern New Mexico	Cool to warm dry	<i>P. engelmannii</i> climax	<i>A. lasiocarpa</i> (minor climax)	<i>S. bronchialis</i> <i>J. communis</i>	DeVelice et al. 1986
<i>Picea engelmannii</i> <i>Senecio cardamine</i> H.T. [ <i>Picea pungens</i> - <i>P. engelmannii</i> <i>S. cardamine</i> H.T.] <i>Abies concolor</i> phase <i>Abies lasiocarpa</i> phase	Blue Mountains, White Mountains, Arizona; Mogollon Mountains, New Mexico	Cool moist	<i>P. engelmannii</i> climax	<i>A. lasiocarpa</i> <i>A. concolor</i> <i>P. menziesii</i> <i>P. pungens</i> <i>P. ponderosa</i> <i>P. strobiformis</i> <i>P. tremuloides</i>	<i>S. cardamine</i> <i>G. richardsonii</i> <i>F. ovalis</i> ( <i>F. virginiana</i> ) <i>V. canadensis</i>	Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Picea engelmannii</i> Moss H.T.	Mountains of New Mexico and Arizona	Cool dry	<i>P. engelmannii</i> climax or co-climax with <i>A. lasiocarpa</i>	<i>A. lasiocarpa</i> <i>P. menziesii</i> <i>P. aristata</i> <i>P. strobiformis</i> <i>P. tremuloides</i>	Moss spp. <i>Ribes</i> spp. <i>Rosa</i> spp. <i>V. myrtillus</i> <i>V. scoparium</i> <i>L. arizonicus</i>	Alexander et al. 1987 Fitzhugh et al. 1987 Moir and Ludwig 1979
<i>Pinus aristata</i> series						
<i>Pinus aristata</i> <i>Ribes montigenum</i> H.T. (Scree forest)	Mountains of northern New Mexico	Cool dry	<i>P. aristata</i> climax	Usually pure stands. May contain <i>P. engelmannii</i>	<i>R. montigenum</i> <i>S. bronchialis</i>	DeVelice et al. 1986
<i>Pinus aristata</i> <i>Festuca arizonica</i> H.T.	Sangre de Cristo Mountains of northern New Mexico	Warm dry	<i>P. aristata</i> co-climax with <i>P. menziesii</i>	<i>P. menziesii</i>	<i>F. arizonica</i> <i>K. cristata</i> ( <i>K. macrantha</i> ) <i>M. montana</i>	DeVelice et al. 1986
<i>Pinus aristata</i> <i>Festuca thurberi</i> H.T.	Sangre de Cristo Mountains, New Mexico	Cool dry	<i>P. aristata</i> co-climax with <i>P. engelmannii</i>	<i>P. engelmannii</i>	<i>F. thurberi</i> <i>R. montigenum</i> <i>A. cordifolia</i> <i>P. delicatum</i> ( <i>P. pulcherrimum</i> )	DeVelice et al. 1986

<sup>1</sup>Muldavin, Esteban, Robert L. DeVelice, and William Dick-Peddie. Forest habitat types of the Prescott, Tonto, and western Coronado National Forests. (Final Report CA 28-K3-307.) (On file, Rocky Mountain Forest and Range Experiment Station, Flagstaff, Ariz.)

<sup>2</sup>DeVelice, Robert L., and John A. Ludwig. Forest habitat types south of the Mogollon Rim, Arizona and New Mexico. (Final Report CA 28-K2-240.) (On file, Rocky Mountain Forest and Range Experiment Station, Flagstaff, Ariz.)

<sup>3</sup>DeVelice et al. (1986) classed all specimens of *P. strobiformis*, *P. flexilis*, and their hybrids as *P. flexilis*, whereas other authors in the southwest recognized only *P. strobiformis*.





Rocky  
Mountains



Southwest



Great  
Plains

U.S. Department of Agriculture  
Forest Service

## Rocky Mountain Forest and Range Experiment Station

The Rocky Mountain Station is one of eight regional experiment stations, plus the Forest Products Laboratory and the Washington Office Staff, that make up the Forest Service research organization.

### RESEARCH FOCUS

Research programs at the Rocky Mountain Station are coordinated with area universities and with other institutions. Many studies are conducted on a cooperative basis to accelerate solutions to problems involving range, water, wildlife and fish habitat, human and community development, timber, recreation, protection, and multiresource evaluation.

### RESEARCH LOCATIONS

Research Work Units of the Rocky Mountain Station are operated in cooperation with universities in the following cities:

Albuquerque, New Mexico  
Flagstaff, Arizona  
Fort Collins, Colorado\*  
Laramie, Wyoming  
Lincoln, Nebraska  
Rapid City, South Dakota  
Tempe, Arizona

\*Station Headquarters: 240 W. Prospect St., Fort Collins, CO 80526